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New drilling rig in tundra faces chilling challenges

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In early March, a small drilling rig perched on a 100-foot-by-100-foot table made of aluminum will commence drilling on the frozen tundra of Alaska's North Slope.

This will be the first use of a platform designed by Anadarko Petroleum for the tundra. It is supposed to be able to double or even triple the number of months when wells can be drilled without fouling this delicate environment.

It will also be Alaska's first well specifically to try to tap methane hydrate, a new and potentially immense source of energy.

In both instances, the challenge has to do with melting.

The platform is designed to continue operating without the expensive techniques needed now to keep oil-field equipment from tearing up the tundra during the summer months, when it turns marshlike.

To tap the methane in the hydrate, workers will need to find a way to melt the ice crystals without using more energy than they produce.

If they succeed, the payoff could be huge.

Methane is the basic ingredient of natural gas, in this case held within a molecular lattice of ice. There is no chemical bond, which makes it different from something like methyl hydrate, a common chemical that shows up in products such as antifreeze.

The Department of Energy calls methane hydrate the "ice that burns," while Anadarko calls its well "Hot Ice No. 1."

Houston-based Anadarko and the department are partners on the well, with the study conducted in partnership with Maurer Technology and Noble Engineering and Development, both parts of Noble Corp., a Sugar Land-based driller.

More and more methane hydrate is being discovered in parts of the world that have the frigid temperatures and the pressures needed for its formation. Among these are the

permafrost regions of Alaska, Canada and Siberia, plus the deep ocean canyons off Japan, Oregon and in the Gulf of Mexico.

The substance has gone from being a scientific curiosity to being a nuisance that clogs deep-water gas pipelines to an energy hope.

"Today, the U.S. Geological Survey estimates that methane hydrate may, in fact, contain more organic carbon than all the world's coal, oil and nonhydrate gas combined," the Department of Energy said in papers explaining its research program.

"The magnitude of this previously unknown global storehouse of methane is truly staggering and has raised serious inquiry into the possibility of using methane hydrate as a source of energy."

The platform

It's just a coincidence that a novel drilling platform was chosen for this test well.

Anadarko's Arctic Platform is designed to extend the drilling season in areas where the ground must be frozen in order for the work to be done. The hope is that it will extend the season from the window of three or four months to eight or nine.

The company has no intention of drilling 12 months out of the year. One reason is that it doesn't want to be in the area during the caribou calving season, said Randy Couch, Anadarko's general manager for technology and planning.

"We are trying to balance the dilemma we face," he said. "We want to get as much oil and gas as possible but balance that with environmental sensitivity."

Some environmental groups, however, apparently have their doubts about the platform.

"This is something we are all going to watch very carefully," Wilderness Society spokesman Pete Rafle said.

Drilling during the warmer part of the year raises concerns.

"That is when the migratory birds are coming through, when caribou are migrating, when other animals are already there. The potential impacts on wildlife could be great," he said.

Alaskan regulators, the federal government and native communities are watching this first test of the platform, Anadarko said.

As for the environmental benefits claimed by Anadarko, the Wilderness Society is reserving judgment until it sees how the platform works, Rafle added.

Hard to get at it

The biggest problem is that the methane from hydrates is difficult to get at.

Nobody has ever produced methane hydrate from a well in meaningful quantities, although researchers have been taking samples and studying them in laboratories for years.

Anadarko estimates that commercial production is 10 to 20 years off, while the federal government says it is committed to commercial production by 2015.

The Department of Energy is putting \$5.4 million into this nearly \$11 million methane hydrate well.

Congress got serious about developing this source of energy when it passed the Methane Hydrate Research and Development Act of 2000.

Projections of the potential energy trapped in methane hydrate help explain their interest.

Worldwide, industry appraisals are that hydrates could contain 700,000 trillion cubic feet of gas, which is 100 times bigger than conventional gas resources estimated at 7,000 trillion cubic feet.

In Alaska, 590 trillion cubic feet of methane hydrate is believed to be onshore, with an even larger 168,000 trillion cubic feet offshore.

In one regard, Hot Ice No. 1 isn't your typical wildcat well because the drillers have a pretty good idea of what is down there.

The drilling location on the North Slope, which is in the heart of Alaska's oil production area, was selected on the basis of wells that have encountered hydrate in the process of searching for oil and gas, and from maps drawn by the U.S. Geological Survey that outline hydrate zones.

Maurer Technology's Thomas Williams, manager of the Department of Energy project, expects to hit a zone of methane hydrate at 1,400 feet, which is just under the permafrost. Then the drill bit will hit a second zone at 2,500 feet.

Altogether, the combined zones of hydrate should be 500 to 1,000 feet thick, Anadarko's Couch said. The permafrost above them is a frozen mass of soil, ice and rocks.

The drillers don't expect to go more than a relatively shallow 3,000 feet, which is about a third of what it takes to reach oil or natural gas in that vicinity.

When they reach that depth, they will take cores out of the well, using drilling mud chilled to 23 degrees so the cores don't melt. A hard-rock coring rig leased out of the Arizona copper-mining region will drill swiftly through the strata, so the cores don't get a chance to change before they can be studied in a mobile laboratory. Then there will be a

short production test of the well, which is proof of the pudding to see how much can be gotten out.

An earlier production test on what is called the Mallik Well in Canada, on the Mackenzie River delta in the Northwest Territories, wasn't able to get a lot of gas out. Workers tried to free it by circulating hot water across the face of the hydrate. All that was produced was a brief flare, Williams said.

Mallik was the world's first well drilled specifically to investigate methane hydrate. The Japanese drilled the second in 3,100 feet of water into what is called the Nankai trough, but little is known of what they learned.

Williams predicts the Anadarko well will do better than Mallik by using another production method. Workers will first swab the well clean of any fluids. The well bore needs to be above freezing. Otherwise, ice will form a barrier for the gas. They will then reduce the pressure and allow the zone to gradually warm up using a heat coil suspended in the tubing.

Small quantities of methane can be released from the hydrate even before it thaws, Williams said.

It is hard to predict how much will come out of the hole. There is a huge expansion factor, he said, with 164 cubic feet of methane capable of coming out of a single cubic foot of hydrate.

There even have been well blowouts blamed on hydrate, one of them not far from Hot Ice No. 1, Williams said, a case of drilling through it without using mud that was chilled.

Drilling will take about 30 days, with the well completion and testing expected to take an extra 14 days.

The "huff and puff" steam injection that is common to the oil industry would provide only temporary benefit, he believes. You don't want to spend more on energy and chemicals than you could get out of the well.

"There has not been an easy history on this," Couch said. "It doesn't just flow out."

The research is considered "frontier stuff," although Anadarko spokeswoman Anne Vincent stressed that the well is being drilled solely for the sake of science.

Applications elsewhere

If this well doesn't work out, Anadarko will be able to put it to use on its conventional oil and gas leases on the North Slope.

As it is, the tundra doesn't freeze solid until about late December, after a few weeks of 20 or 30 below, and when it starts warming up toward the end of April "you have to be out of there," Vincent said.

In recent years this window has been shortening, which some say is a sign of global warming. That means it can be years before workers do the drilling needed to define a field and put it into production.

Its legs get the platform 12 feet off the ground, so animals don't have to go around it. It can be used for exploratory drilling and for production. It is big enough to hold a drilling rig and auxiliary equipment, such as mud tanks. A channel along the edge reduces the potential for spills.

If, on the other hand, the well turns out to be a dry hole, the platform can be taken apart and hauled away. Once the holes are filled, there are few signs it was there, Vincent said.

The platform eliminates the need to build gravel pads, which can leave long-lasting scars.

From a design standpoint, the platform is made out of 16 aluminum modules that fit together like Lego pieces, each with its own legs. The legs are made of steel, with coarse threads on the ends that screw into the ground. This means they don't have to be as deep as offshore pilings, which are pounded in.

The pieces can be carried on Rolligon all-terrain vehicles, which have fat tires that don't sink into the tundra. Also, the modules are light enough to be moved by helicopter.

Anadarko's technical group in Houston designed the platform, with the modules built here by an unidentified fabrication company. Anadarko has a patent pending on the design.

From Houston, the pieces were hauled to Seattle by truck, put on a boat to southern Alaska and finally moved by Rolligon across the tundra to the well site.

This avoids the cost of building ice roads, which are preferred over gravel for environmental reasons. Chipping machines grind up the ice in lakes, which can be spread like gravel. Water can also be sprayed by trucks, freezing on impact.

Anadarko holds leases in the foothills of the Brooks Range, a remote area where there isn't as much water, said Bill Van Dyke, a supervisor in the permitting department of the Alaska Department of Natural Resources, oil and gas division.

"If you build a road 60 or 90 miles long, and a pad, you use a heck of a lot of water," Van Dyke said.



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